II.—Notes on British Dinosaurs. Part I: *Hypsilophodon*.

By Dr. Francis Baron Nopcsa.

(WITH A PAGE-ILLUSTRATION.)

During a recent stay in London the kindness of Dr. A. S. Woodward enabled me to study some of the splendid Dinosaurian remains in the British Museum.

Having principally occupied myself till now with Ornithopodous Dinosaurs, first of all *Hypsilophodon* attracted my attention, and my expectation that this type would prove to be the clue for the understanding of all the other Orthopoda has been perfectly fulfilled.

Hypsilophodon was described and figured at various times by Owen, Huxley, and Hulke; a restoration of this animal was given by Marsh in the Geological Magazine for 1896 (p. 6, Fig. 2), and the complete bibliographical list concerning this Dinosaur is compiled in my paper "Synopsis und Abstammung der Dinosaurier" (*Földtani Közlöny*, 1901, Budapest).

In consequence of our more recent knowledge of Dinosaurs in general I managed to detect some new points of remarkable interest.

Mandible. What Hulke, in describing the *Hypsilophodon* skull, No. 110, supposed to be the parietal, frontal, and post-frontal bones (Phil. Trans., 1882, pl. lxxi, fig. 1, *pa.*, *fr.*, *ps.f.*), turned out to be the outer view of a complete right mandibular ramus, so that the parietal changes into an articular, the frontal becomes the dentary, and the post-frontal the coronoid bone. This piece (p. 207, Fig. 4) is, in fact, the finest mandibulum of *Hypsilophodon* I have seen in the whole collection, and as such worthy to be refigured.

The general outline of the mandibulum, with its strongly abbreviated post-coronoidal part and its blunt processus coronoideum, reminds one somewhat of the under jaw of *Placodus gigas*, though it differs of course in nearly every detail, being built up after the *Iguanodon* type. The comparatively very slight elevation of the blunt coronoideum, a feature in which *Hypsilophodon* differs from *Iguanodon* and the Hadrosauridæ, is to be met with in the Upper Cretaceous *Mochlodon*, while the abbreviation of the post-coronoidal part of the lower jaw is a character which among all Dinosaurs is only known in the *Iguanodon* type.

So-called sclerotic plates. After fixing former differences of interpretation Hulke's so-called sclerotic plates were closely examined, and proved to be nothing else but the teeth belonging to the very same mandible, showing each a nicely polished masticating surface; the pointed projection on each of these so-called sclerotic plates being simply due to the median ridge projecting on the inner enamelled surface of each tooth (compare my similar figure of the masticating surface in *Mochlodon* teeth figured in my paper on *Mochlodon* in the Denkschr. d. k. Akad. Wiss., Vienna, 1901, pl. ii, fig. 11).

Basi-occipital bone. Another point of great interest not yet duly noticed in the skull of *Hypsilophodon* is the shape of the *bird-like* basi-occipital bone (Fig. 1, *bo.*). It is utterly unlike the same

bone in *Camptosaurus, Mochlodon, Iguanodon*, or *Telmatosaurus*, but rather reminding one of the *Compsognathus* or *Thecodontosaurus* type; and the *downward* direction of the foramina by which the cranial nerves pass out from the brain-cavity along the basal and lateral elements of the skull is an especially bird-like feature. Describing the basi-occipital and basi-sphenoidal elements in *Mochlodon*, I stated these elements in *Gresslyosaurus* are in the same relation to the same parts in *Zanclodon* as are those of *Mochlodon* to *Telmatosaurus*, and thus I could distinguish a *Mochlodon - Gresslyosaurus* or elongated and a *Telmatosaurus-Zanclodon* or abbreviated type. To this now a third type, the *Hypsilophodon-Thecodontosaurus* or bird-like type has to be added. The great phylogenetic and physiologic value of this fact, throwing much light on the relationship of Dinosaurs and birds and also on Dinosaur evolution itself, will be more fully explained on some other occasion.

Supra-occipital bone (p. 207, Fig. 2). As it has some years ago been doubted by Professor Koken that in Ornithopodidæ the supra-occipital enters into the foramen magnum (Neues Jahrb. f. Min. Geol. u. Pal., 1901, vol. i), it seemed desirable to settle also this question, and therefore a drawing of this part of another *Hypsilophodon* skull is also given. It will be seen at once that the supra-occipital contributes largely to the boundary of the wide foramen magnum, and that it rises very much in the same way as in *Hatteria* or *Compsognathus*, forming at the same time a sharp median posterior crest. The differences from the *Acanthopholis* or even the *Iguanodon* type are easily noticed. The processus parotici are not raised as in *Telmatosaurus*, but at the same level as the foramen magnum, and, showing at once where the missing squamosals are to be sought for, this indicates that the quadrate bone was *comparatively* short, that the superior temporal openings were visible from the side, and proves the presence of large hypoparotic fossæ.

Predentary. Although this bone is of quite exceptional interest, and was already described by Hulke in his monograph on *Hypsilophodon*, yet it never has been figured. *Hypsilophodon* is, as far as we know, the single Dinosaur in which a tooth bearing a præmaxillary comes to bear down on a predentary bone, and this is the reason why in p. 207, Fig. 3, an enlarged drawing of this element is given.

Dollo remarked some years ago that a toothed præmaxillary might well correspond to a tooth-bearing predentary, and I perfectly agree with the famous Belgian professor that this is exactly the thing one ought to expect if the predentary of the Orthopoda were an entodermal ossification and homologous with the same bone in *Aspidorhynchus, Amphignathodon*, or in human anatomy.

Working along quite other lines of research than Professor Dollo, I, however, recently came to the result that the predentary of Orthopoda cannot have been derived from a cartilaginous source, but must simply be regarded as a dermal ossification (Denksch. Akad., Vienna, 1904). The paradoxical fact that in *Hypsilophodon* an edentulous predentary meets a toothed præmaxillary is, as far as

I am aware, the best evidence that can be brought forward in favour of the newer interpretation. A comparison of this predentary bone with the one of *Mochlodon* and other Predentata, as figured in my third paper on Transylvanian Dinosaurs, is equally interesting, and the gradual prolongation of this bone along the line *Camptosaurus*, *Telmatosaurus*, and *Trachodon* may perhaps be termed as a sort of dolichocephaly due to the cursorial habits of these Phytophagous reptiles.

Præmaxillary. No doubt has hitherto been expressed regarding the statement that the front part of the jaw in *Iguanodon* was covered with a horny beak, and therefore an examination of the tooth-bearing præmaxillary in *Hypsilophodon* was also one of the tasks that had to be accomplished.

On the top of the well-preserved præmaxillary of one skull (Hulke, 1882, pl. lxxi, fig. 1), soon a small but pronounced rugosity was detected, and it was at once highly suggestive that this might be the place whence that dermal ossification originated which, spreading by and by over the whole præmaxillary, gradually formed the beak of the Orthopodous Dinosaurs and suppressed the function of some teeth. That this beak did, however, not yet act effectively in *Hypsilophodon* is, I think, proved by the presence of the well-developed præmaxillary teeth. As placed on the front part of the præmaxillary the rugosity mentioned is at the same time exactly on the place where in some reptiles and birds the *Eischwiele* of the German author appears, and the idea that this is more then a mere coincidence is perhaps not to be disregarded altogether.

Dermal ossifications (armour). Contrary to what we know of *Iguanodon*, *Hypsilophodon* was surely clad with a thin but a well-developed dermal armour, consisting of comparatively large yet thin and flat, feebly punctured bony plates. I managed, at least, to detect in more than one specimen some plates always showing the same sort of feebly grooved sculpture, and never referable to any part of the endoskeleton itself. A good sketch of such plates is given in one of Hulke's figures, and in p. 207, Fig. 4, of this paper the grooved markings also come out pretty well. This dermal armour is, again, a character in which *Hypsilophodon* approaches more closely the armour-clad Stegosaurs and Ceratopsia than any other Ornithopodous Dinosaurs.

Ossified dorsocaudal tendons. The first figure of ossified dorsocaudal tendons in a Dinosaur dates back to the year 1849, and is a figure representing parts of the tail of *Hylæosaurus*. Later on the same elements were mentioned by the Rev. W. Fox in *Polacanthus* (*Illustrated London News*, 1865). Again, in 1882 a figure and a short remark on these curious objects was given by Hulke in his *Hypsilophodon* paper, and in 1887 they were refigured very clearly in his paper on *Polacanthus*. In the same year (1887) came finally L. Dollo's paper mentioning them in *Iguanodon* and dealing with their physiological value. Thus ossified dorsal tendons are present in all the British Prædentate reptiles, with the sole exception of the

Liassic *Scelidosaurus.* It is to be remarked that (1) the rhomboidal arrangement of these tendons described in *Iguanodon* seems to be absent in *Hypsilophodon* as well as in the North American *Claosaurus*; (2) that in *Iguanodon* these ossifications are *absent* under the diapophysis, while in *Hypsilophodon* they are present also on this place, and form thus on each side of the tail two bundles which run along the neurapophyses and the chevron bones. Besides this the ossified tendons attain in *Iguanodon* their maximum of development in the lumbar region, while in *Hypsilophodon* their number augments the nearer we approach the end of the tail, so that this region is *entirely* ensheathed. The physiological value of such a rigid organ, already unexplainable in *Iguanodon*, becomes in consequence entirely a puzzle.

Fourth trochanter. Though the fourth trochanter of *Hypsilophodon* was already well figured and described by Hulke, I still feel induced to mention also this part, since Hulke in the *Neues Jahrbuch für Mineralogie* expressed some time ago his doubts about the correctness of my assertion that the 'trochanter pendant' represents a more primitive stage in evolution than the 'trochanter en crête.' Now I find that the trochanter pendant of *Hypsilophodon* just seems to prove the correctness of my original view. In *Hypsilophodon* the fourth trochanter is comparatively much broader than in *Camptosaurus,* where it also shows the pendant type, and in the Wealden *Iguanodon,* again, it is much more developed than in *Trachodon,* of the Belly River and Laramie Series. Comparing this fact with the development of the teeth in these animals, we find that the more complex development of the teeth runs parallel with the diminution of the fourth trochanter. At the same time the diminution of the fourth trochanter is also accompanied by the development of what I formerly called the processus pectinealis of the Orthopode pelvis (*Földtani Közlöny,* 1899, Budapest), but for which I now adopt the more appropriate name of processus pseudopectinealis. As it is now possible to prove that the development of the processus pseudopectinealis as well as the more complex structure of the teeth are due to *progressive* and not to *retrogressive* evolution, and since it is impossible to suppose that some sort of quite especial *chevauchement de specialisation* is disturbing the *whole* line from *Hypsilophodon* to *Trachodon,* it is equally impossible to sustain the view that the smaller fourth trochanter represents the primary-state, and on account of this I think the fourth trochanter in *Hypsilophodon* may be brought forward as one of the principal arguments for sustaining my hypothesis concerning the fourth trochanter.[1]

Conclusion. The following characters in *Hypsilophodon* can be considered as new or definitely settled:—No sclerotic ring. Coronoidal process blunt and low. The dermal predentary certainly edentulous. Præmaxillary with rugosity on the front end. Condylus basi-occipital, and the whole base of the skull very bird-like, reminding us more of some Theropoda than of the true Ornithopodidæ.

[1] Other arguments I intend discussing upon another occasion.

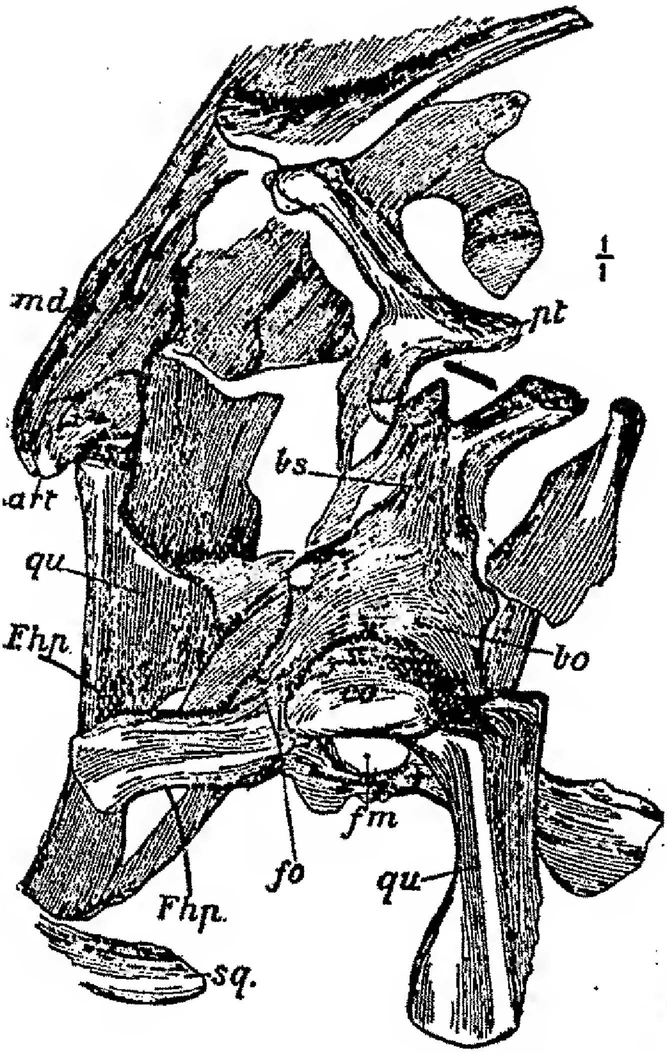

Fig.1

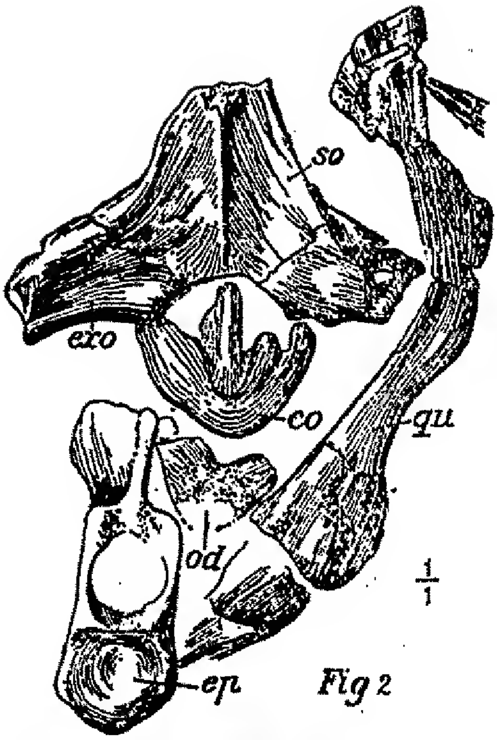

Fig 2

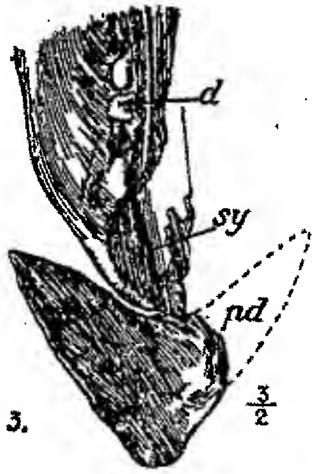

Fig 3.

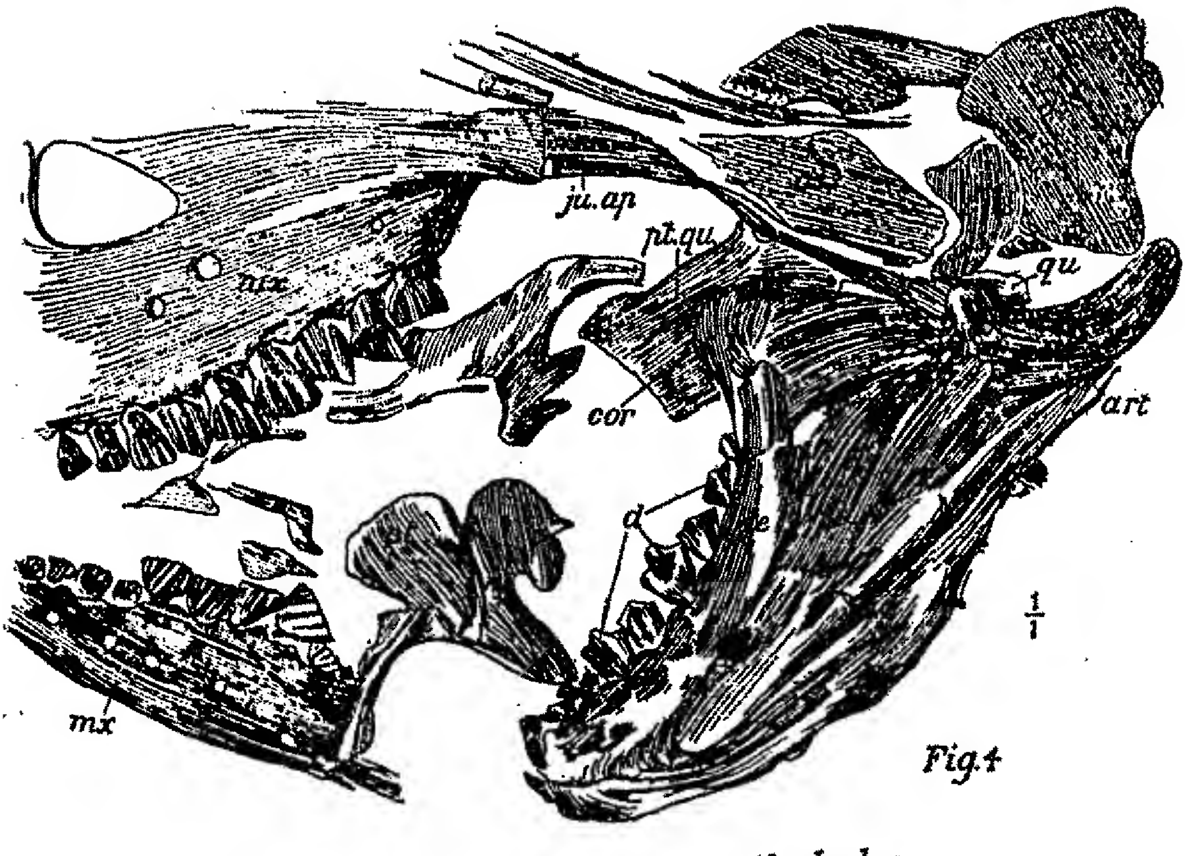

Fig.4

British Dinosaurs : I. *Hypsilophodon.*

Supra-occipital entering largely into the foramen magnum. Processus parotici not raised. Large fossa hypoparotica present. Dermal armour present and well developed. Ossified dorsocaudal tendons run along neurapophysis and chevron bones, and augmenting in number towards the end of the tail.

EXPLANATION OF PAGE-ILLUSTRATION (p. 207).

FIG. 1.—Base of skull of *Hypsilophodon* ($\frac{1}{1}$).
,, 2.—Back of skull of *Hypsilophodon* ($\frac{1}{1}$).
,, 3.—Predentary of *Hypsilophodon* ($\frac{3}{2}$).
,, 4.—Mandible of *Hypsilophodon* ($\frac{1}{1}$).

art. articulare.
bs. basi-sphenoid.
co. condylus.
cor. coronoideum.
d. dentes.
de. dentale.
ep. axis (epistropheus).
exo. exoccipitale.
f.hp. fossa hypoparotica.
f.m. foramen magnum.
fo. foramina of cranial nerves.
ju.ap. jugal apophysis of maxillary.
md. mandibulum.
mx. maxillare.
od. processus odontoideus.
oss. dermal ossifications.
pd. predentary.
p.p. processus paroticus.
pt. pterygoid.
pt.qu. processus pterygoideus quadrate.
qu. quadratum.
so. supra-occipitale.
sq. squamosum.
sy. symphysis mandibuli.

III.—ON A LEPIDODENDROID STEM FROM THE COAL-MEASURES.

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AMONG the numerous Lepidodendroid remains in the Geological Department of the British Museum (Nat. Hist.), there is one which presents several characters of unusual interest. It is a cast, obtained from the Middle Coal-measures of South Staffordshire, near Dudley, and belongs to the Johnson Collection.[1]

A portion of the specimen is figured on p. 209. It will be noticed that the mammillated leaf-cushions are distant from one another, and are separated by broad bands of striated bark. This is an unusual feature in the case of British Lepidodendra. The preservation is fairly good, except in the details of the leaf-scar. In the specimen thirteen leaf-cushions are represented, forming portions of five spiral series. The cushions are rhomboidal in outline, and at first sight do not appear to be very sharply marked off from the bark. On closer inspection, however, they are seen to be moderately well defined, although the lateral angles are flattened and obscured by the encroachment of the bark. They measure from 1·8 to 2 cm. in length, and from ·6 to ·7 cm. at their greatest width. The upper and lower extremities lie in one plane, which is the median plane of the cushion, and are inclined neither to the right nor to the left (cf. *Lepidodendron serpentigerum*). The cushions stand out in high relief, and depart somewhat from the form of a low truncated pyramid so commonly seen amongst Lepidodendra. However, this is in no wise remarkable, for examples of Lepidodendra having raised cushions

[1] Registered number V. 1233.